

Exposure to metals: are we protecting the workers?

Ellen K Silbergeld, Virginia M Weaver

Metals are toxic to adults too

Several metals and metalloids, including lead, cadmium, mercury, manganese and arsenic, are among the most extensively studied environmental and occupational health risks. As a result of such research, public health policy decisions in many countries have reduced environmental exposures by restricting uses and releases. However, occupational health policy has not kept pace. In part, this reflects a policy gulf in public health, dividing considerations of children's health from that of adults. Driven by justified concerns about children's exposures and responses,¹ the children's environmental health movement may have generated an unintended assumption that adults are not at risk from similar exposure to the same toxic agents. The failure to critically examine this assumption adversely affects the protection of working adults. In addition, failure to consider health effects on adults can bias risk-based policies when the potential benefits of interventions are analysed only in terms of reducing risk to children.

Much recent concern for children's environmental health came from experience with lead and mercury. To prevent neurodevelopmental toxicity from these metals, public health decisions in many countries during the past 30 years have focused on fetal and early childhood exposure. On this basis only, some policies also cover adult women in their reproductive years. Child-specific biomonitoring guidelines have also been developed and serve as a basis for policy in the USA. By contrast, there has been little change in policy regarding exposures of adults (aside from women as "vessels of the fetus"). The occupational guidelines and standards promulgated by the Occupational Safety and Health Administration (OSHA) in the 1970s for lead and mercury were largely based on preventing acute toxic effects. Similar standards have been recommended by the International Programme on Chemical Safety, and adopted by many other countries (World Health Organization 1991, 1995). Unlike EPA, there are no legal requirements for

periodic review by OSHA of relevant new data to determine whether existing standards should be revised.

However, exposures to lead and mercury continue in many industrial settings. Use of lead continues to grow worldwide, largely driven by expanded battery production (www.leadaint.org). Currently, in the USA, most persons with increased blood lead levels are exposed occupationally. Moreover, despite an overall decline in occupational exposure to lead in the USA, higher exposures persist in smaller and less closely regulated workplaces.² Industrial uses of mercury have also decreased, but mercury continues to be used in many industrial settings, such as chloralkali production, fabrication and use of switches and pressure gauges, and in small-scale gold mining in many regions of the world. However, fewer data are available on occupational exposure to mercury, as the OSHA permissible exposure limit for mercury does not require medical surveillance such as that for lead.

Moreover, older Americans in most cases now have higher blood lead levels than children <6 years, and they have experienced less decline in blood lead levels after the phasing-out of lead in gasoline.³ The case of mercury is similar. Both blood and hair mercury levels are considerably higher in women than in children in the USA.^{4,5} For lead, part of this difference may be due to a cohort effect, because of the influence of past (and higher) exposures on bone levels; however, for mercury, this is unlikely, as both hair and blood mercury levels denote relatively recent exposures.

The policy acceptance of higher levels of exposure for adults, compared with children, could be justified if adults are truly less sensitive to lead or mercury. Recent research in environmental epidemiology challenges this assumption. This research, with large numbers of participants, and stronger designs and statistical analyses, has resulted in an increased ability to detect associations between relatively low exposures and adverse

outcomes. A considerable epidemiological literature now indicates that lead can adversely affect health in adults at exposures within the lower range associated with neurocognitive effects on young children (<10 µg/dl). For example, a recent study of lead and mortality reported substantially increased risks of all-cause mortality and mortality from cardiovascular disease at blood lead levels >2 µg/dl.⁶ Similarly, a recent review of the epidemiological literature on exposure to lead and chronic kidney disease concluded that increased risk was present at blood lead levels <5 µg/dl.⁷

For mercury, in studies of adults exposed both environmentally and occupationally, neurological effects have been reported at levels of exposure well below current occupational guidelines and in many of the same domains as reported in children.^{8,9} In addition, cardiovascular effects of mercury have been reported in adults in the same range.¹⁰ Immunotoxicity is a new area of research in mercury toxicity. Two case-control studies provide suggestive evidence to associate exposures to mercury with autoimmune diseases. It is also important to note that occupational exposures often involve elemental or inorganic mercury. Inorganic mercury is more toxic to the immune system than methyl mercury, and inhalation of mercury vapour results in rapid distribution to and accumulation in the brain.¹¹

There are considerable implications of this briefly reviewed knowledge on exposure and toxicity for occupational and environmental health policy and practice. Clearly, there is an urgent need to re-evaluate current occupational standards for lead and mercury. Exposure in workers must be controlled not only to prevent acute toxicity but also to protect against cumulative effects on target organs, such as the heart, brain and kidney, during the life span. An expert panel of the Association of Occupational and Environmental Clinics recently concluded that "Current occupational standards [for lead] are not sufficiently protective and should be strengthened".¹² OSHA requested information on the health effects of lead in 2005, but there has been no policy change to date. The situation is similar for mercury. In 1989, OSHA proposed the adoption of a lower permissible exposure limit for inorganic mercury in the workplace (0.05 mg/m³) as part of the Air Contaminants Standard, but after this ruling was rejected by the courts in 2001, no further regulatory activity has been initiated. This illustrates the barriers to evidence-based policy change faced by OSHA in many areas of occupational health.

In addition, risk assessments in public health policy are distorted by failures to assess the effects on adult health. For example, current arguments for further controls on sources of both lead and mercury have been couched solely in terms of their effects on children,¹³ and the balance of costs and benefits have been disputed on this basis.¹⁴ Public health may also be affected when decisions are made without consideration of adult exposure. For example, during the 2004 episode of drinking water contamination in Washington, DC, drinking water testing was limited by the health department to homes with young children or pregnant women.¹⁵ In terms of practice, health practitioners and public health officials are often at a loss to respond to concerns about exposures for adults not employed in workplaces with exposure to metals.

In conclusion, an increasing body of literature indicates that adults remain at risk for exposure to metals at levels that have substantial adverse health effects. Protection of both children and adults must be considered in the promulgation

of regulatory limits for widespread toxicants such as metals and persistent organic pollutants.

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Authors' affiliations

Ellen K Silbergeld, Virginia M Weaver, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland USA

Correspondence to: Dr E K Silbergeld, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA; esilberg@jhsph.edu

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